# Rapid Response Technology Trade Study Tool – R2T2

## Technology Management of Systems in Practice

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# Agenda



- *Background*
- *Technology Refreshment – Obsolescence Driven*
- *Technology Assessment – Input data*
- *Technology Refreshment Strategy and Plan*
- *R2T2 Description – A Technology Management Approach*

# Background



***Started with an interest in being able to predict how often change must occur to a system in order to mitigate the impacts of individual component obsolescence, especially in COTS systems.***

***Note that a component in this definition can be a part at any level in the hierarchy.***

***<u>Programs of initial interest were</u>:***

- ***JSF (F-35) - Started the interest with planned TR and TI during development window and management of a COTS-intensive solution, particularly at the board and sub-assembly levels.***
- ***SLVR - Super Low and Very Low Frequency Radar offered a small-sized project to test the manual process that evolved into the R2T2 web-based (ASP format) engine.***
- ***ACS - Aerial Common Sensor (Army) Concept Exploration phase allowed for further refinement of the model and initial validation.***
- ***ARCI – Acoustic Rapid COTS Insertion, Advanced Processing Build***

# Technology Refreshment Strategy

## With Escalating Technology Performance

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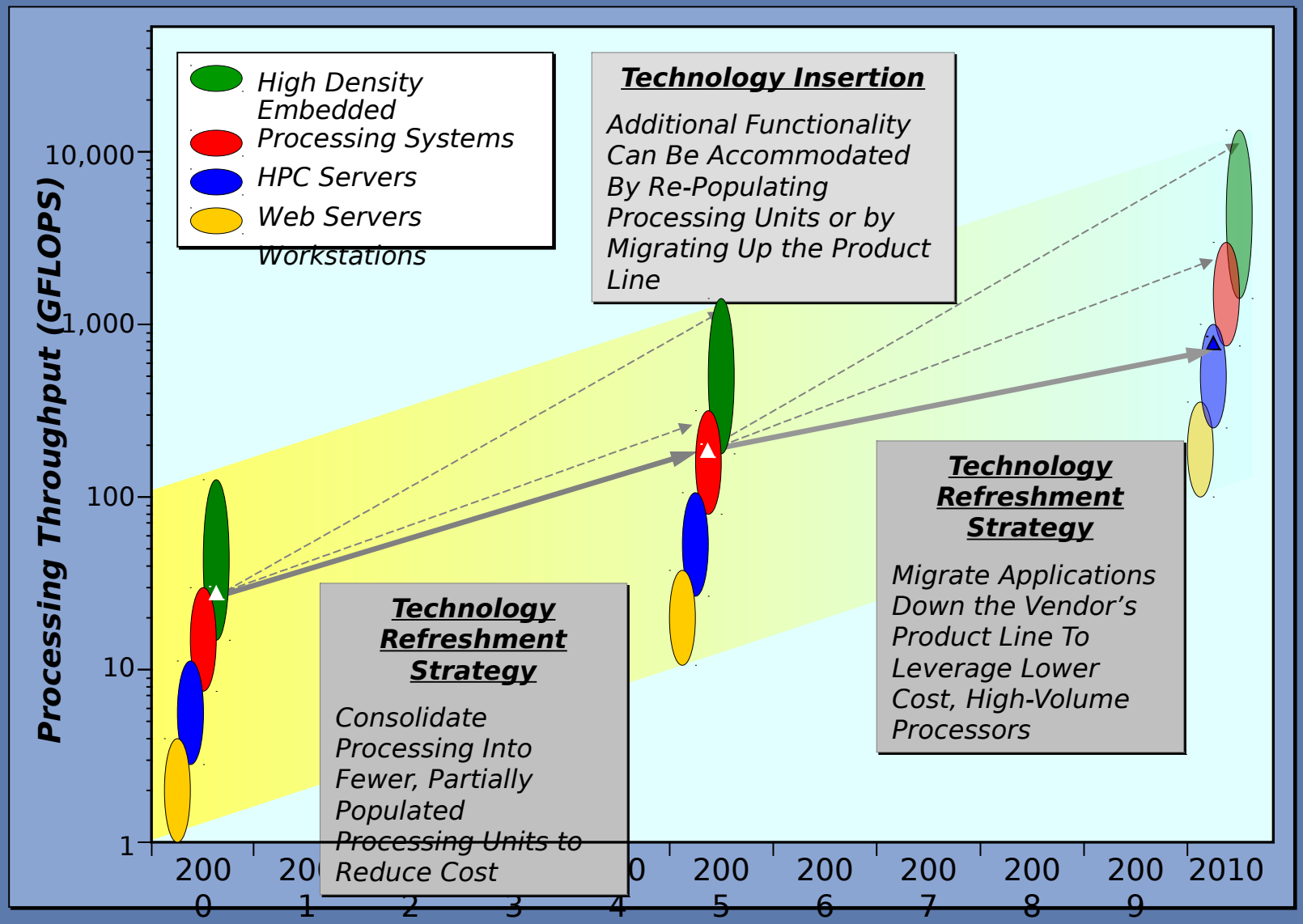

# Open Standards Evolve Too!

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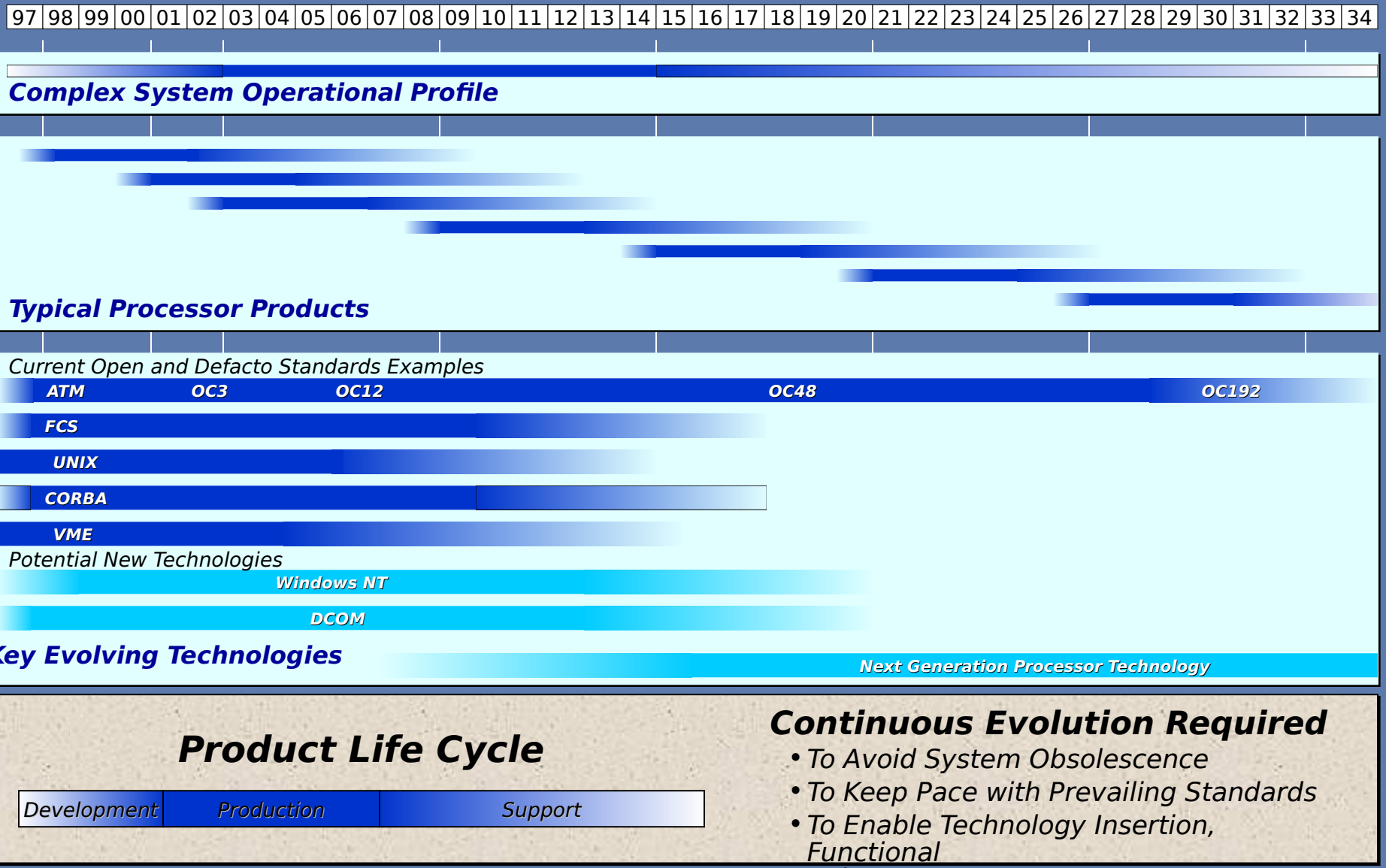
97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
Complex System Operational Profile
Typical Processor Products
Current Open and Defacto Standards Examples
ATM
OC3
OC12
OC48
OC192
FCS
UNIX
CORBA
VME
Potential New Technologies
Windows NT
DCOM
Key Evolving Technologies
Next Generation Processor Technology

## Product Life Cycle

| Development | Production | Support |
|---|---|---|

## Continuous Evolution Required

- To Avoid System Obsolescence
- To Keep Pace with Prevailing Standards
- To Enable Technology Insertion, Functional Enhancement

# Technology Refresh Process

## Strategy & Plan Development

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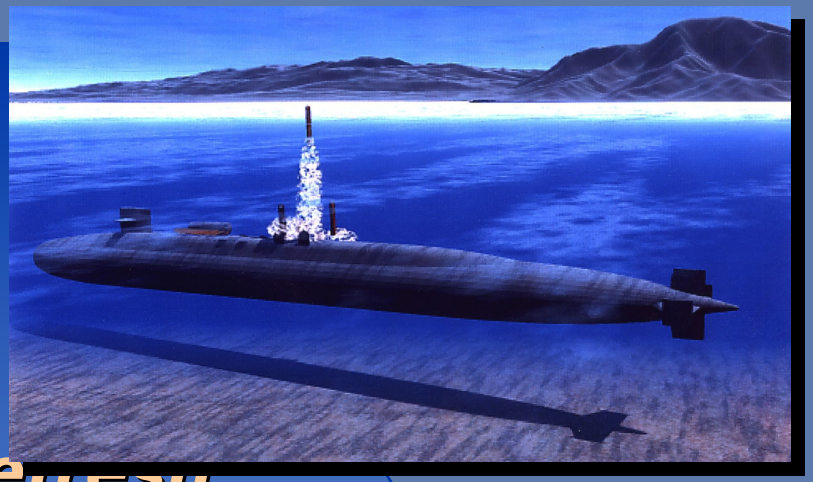


### Assess Each Product

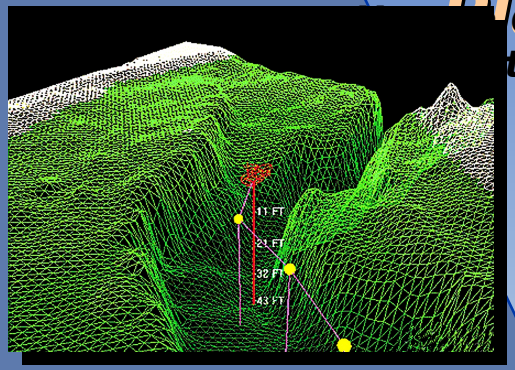
- Selected Open Standards Conformance
- Technologies Employed
- Current Status of Each
  - Technology Life Cycle
  - Technology Change Frequency
  - Technology Obsolescence
  - Current Technology Maturity

### Develop Technology Refresh Strategy

- Plan for Cost Effective "State-of-the-Practice Bathtub Curve"
- Keep in "State-of-the-art" Product Announcements + 4 Levels
- Use System Assessment to Set a Tech Refreshment Frequency
- Maintain Open Standards Conformance Only As Required for TOC Benefits

### Develop Technology Refresh Plan

- Minimize Architectural Re-Design Cost
- Unique Solution for Each Subsystem
- Technology Refreshment Roadmap
- Integrate the Unique Solutions
- Create Matrix (W/Subsystems As X-Axis & Tech Refreshes As Y-Axis)
- Synchronize with Any Known/Projected Functionality Upgrade Plans



# Technology Refreshment Strategy

## Based on Technology & Product Assessments

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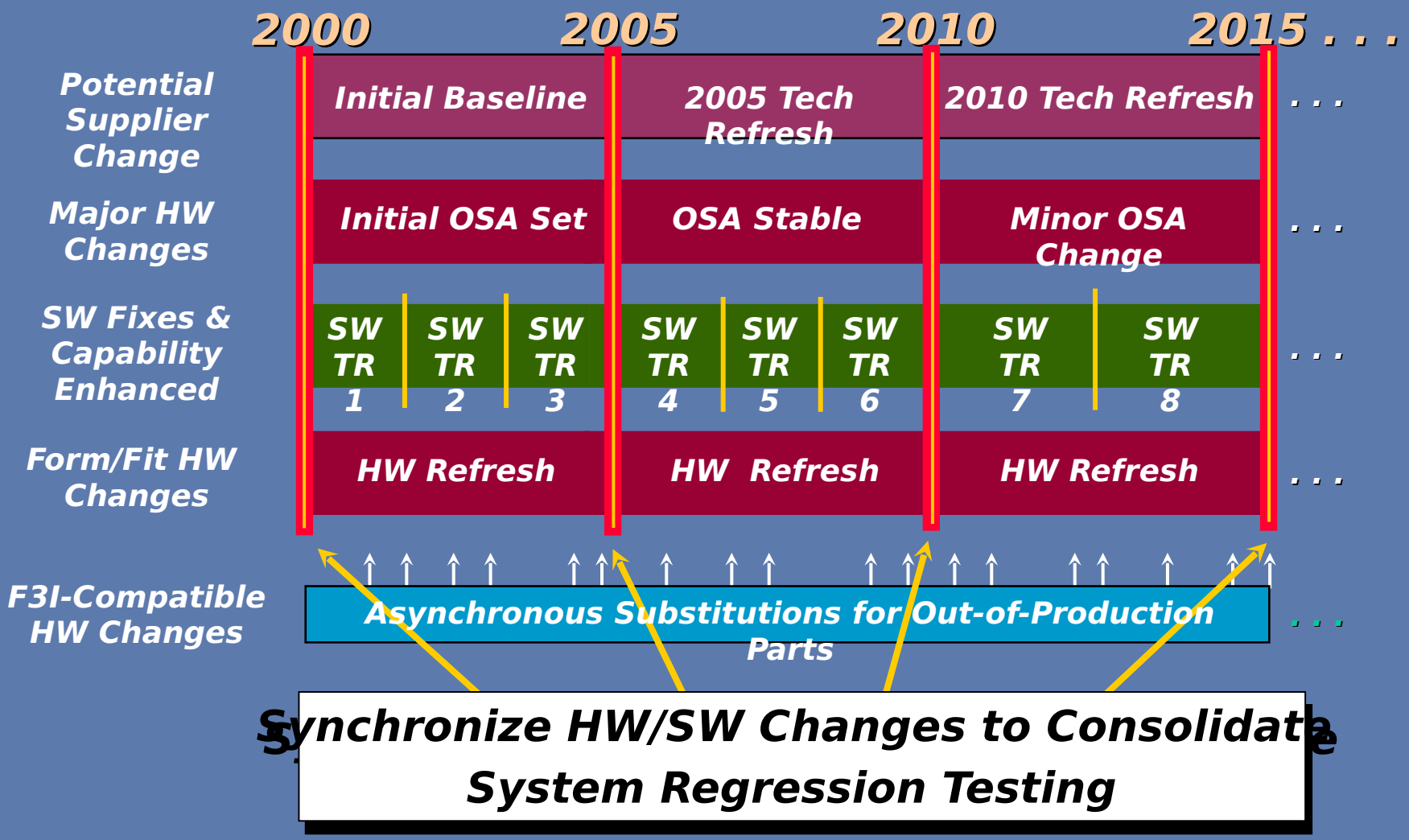
## Example = TR every 5 years:




**Synchronize HW/SW Changes to Consolidate System Regression Testing**

# R2T2 Technology Refresh Strategy

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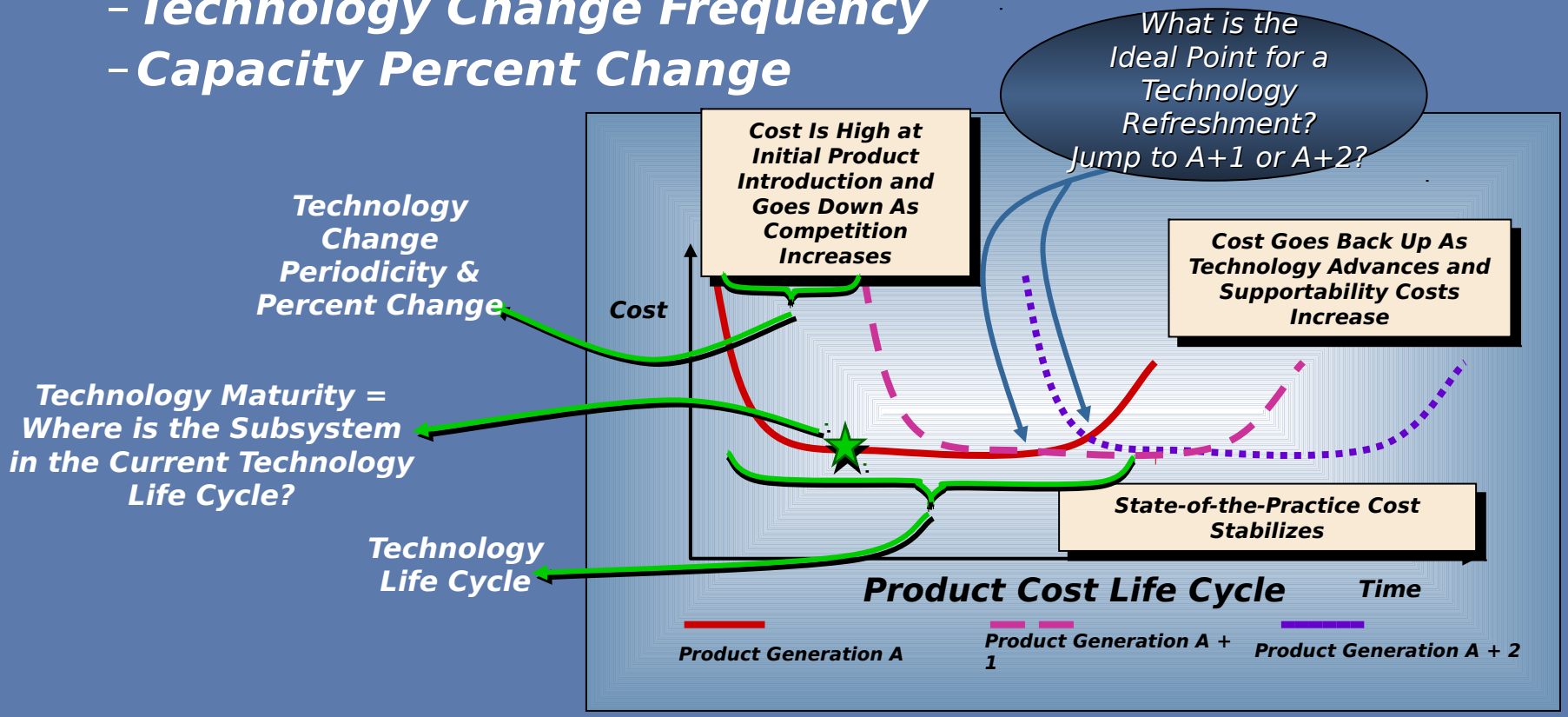
## Technology Refreshment Strategy

### Development

- Technology Life Cycle for Each Product
- Technology Maturity for Each Product
- Technology Change Frequency
- Capacity Percent Change


What is the Ideal Point for a Technology Refreshment? Jump to A+1 or A+2?
Cost Is High at Initial Product Introduction and Goes Down As Competition Increases
Cost Goes Back Up As Technology Advances and Supportability Costs Increase
State-of-the-Practice Cost Stabilizes
Technology Change Periodicity & Percent Change
Technology Maturity = Where is the Subsystem in the Current Technology Life Cycle?
Technology Life Cycle
Cost
Product Cost Life Cycle
Time
Product Generation A
Product Generation A + 1
Product Generation A + 2

# Technology Change Considerations

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## NRE Cost for Refreshments

- *High cost for High Refreshment Frequency (i.e. annually)*
- *Low cost for 15-year modernization method*

## Support Cost Element

- *Small Cost for High Refreshment Frequency (i.e. annually) – Low Need for spares procurement, but greater Configuration Management (i.e. Technical Documentation and Training)*
- *High Cost for "bridge buys" to end of long refreshment frequencies (i.e. 10 – 15 years in length)*
- *Cost due to end of phase high dollar investment, sunk cost, budget inefficiency.*
- *Two Factors: MTBF and Obsolescence*

*See Next Slide for Graphical View . . .*

# Technology Change Cost Graph

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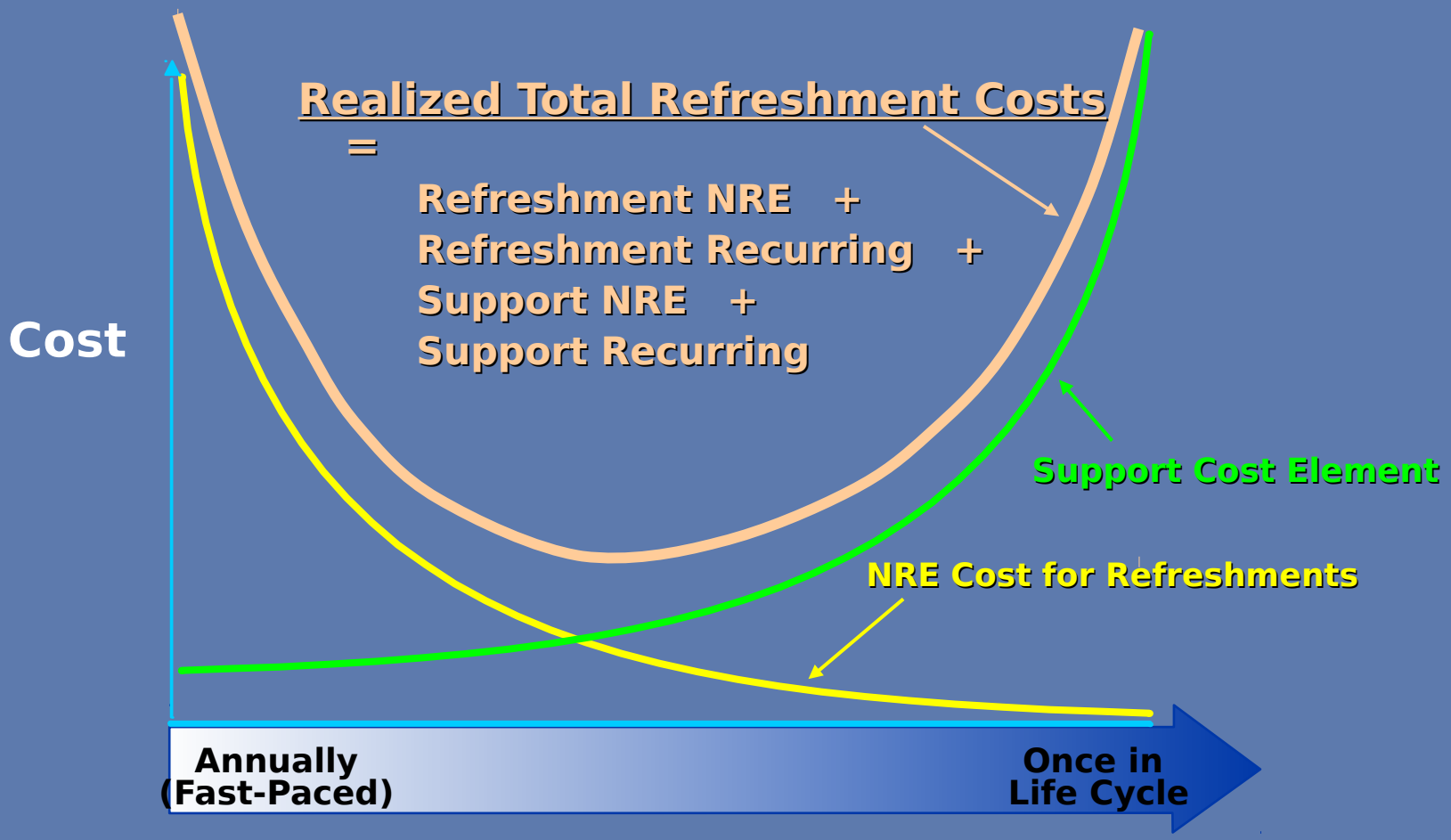


*Finding the Balance of Support and Change*

# Technology Management Summary



## Technology Refreshment Is a Necessary Fact of Life for COTS-Based & Custom-Designed Systems

- *Required for Supportability*
- *Reduces Cost of Ownership*
- *Allows Continuous Exploitation of Exponentially-Improving Technology*
- *Facilitates Introduction of Advanced, Processing-Intensive Functionality*

## Effective Planning for Technology Refreshment Based on:

- *Comprehensive Technology Strategy and Plan To Accurately Anticipate Technology and COTS Product Directions*
- *Implementation-Independent Design To Enable Low Cost Exploitation of Emerging COTS Products and Advanced Technologies*

# R2T2 Summary & Abstract

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## *Summary of the Intent*

**Rapid Response Technology & Trade Study methodology and aid for Technology Forecasting and Strategy Recommendations (especially useful during proposal and early conceptual phases)**

## *Abstract*


***Current noteworthy industry capabilities are focused on component-level obsolescence predictions (such as TACTrac, i2 LCE and MOCA) and look to predict only the "next" obsolescence issue. This R2T2 technology assessment engine permits the level of abstraction to be raised to sub-assembly, unit, sub-system and the system level in support of System-of-Systems design. This tool also focuses on the technologies and their behavior (based on history and/or user knowledge inputs). The algorithm for assessing a system behavior from the aggregation of the technology elements is the heart of this research.***



**See Enhanced Function Flow Block Diagrams on following pages**

# R2T2 High-Level Description

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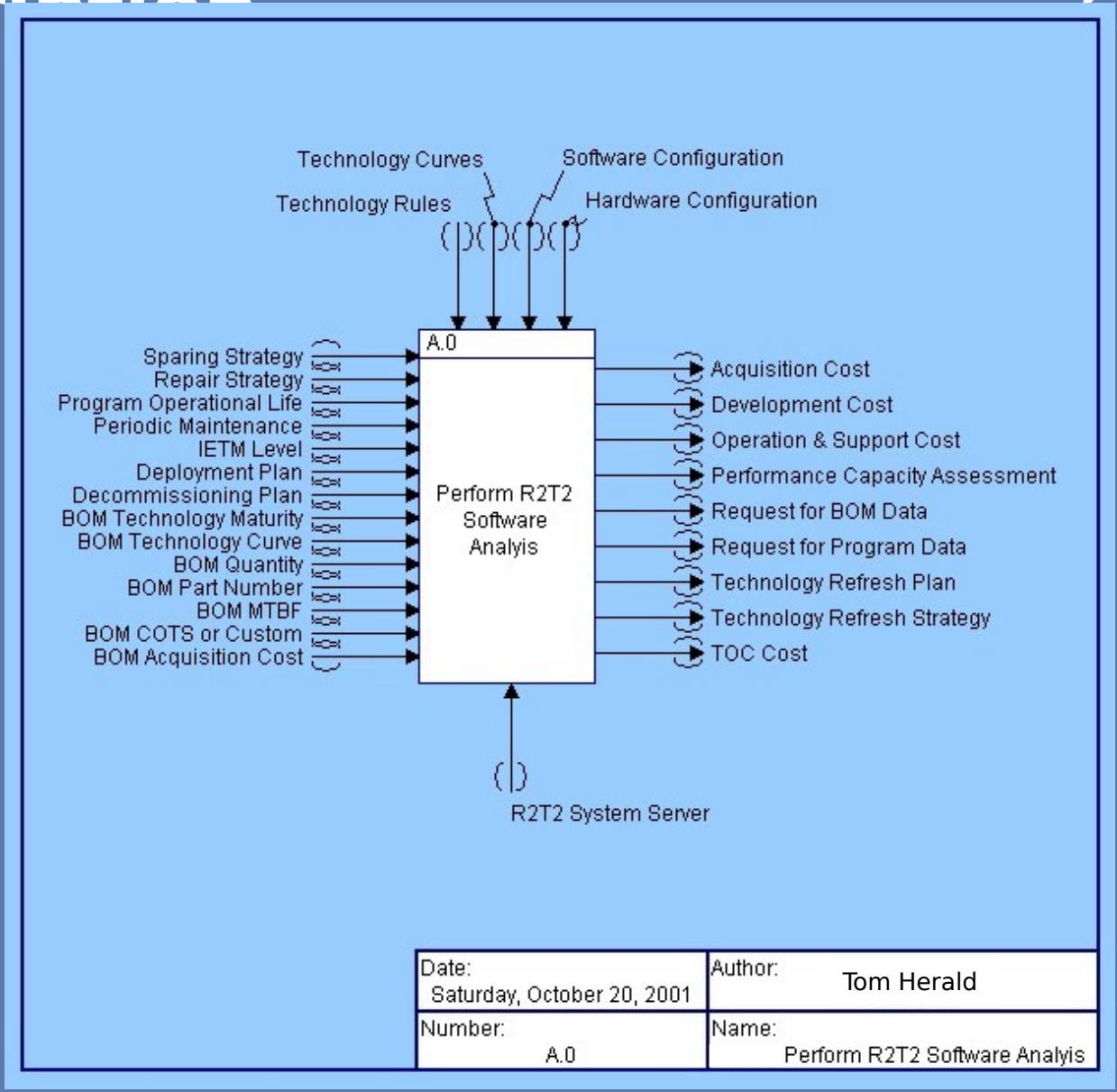

# Problem to Solve

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## The Needs:

- Rapid Response Technology Assessment Mechanism that can support Proposal Trades, CE Trades as well as Development phase.
- Give a Rapid Response to a Technology Assessment (on order of hours, not weeks)
- Give an "80% accurate" full life Cost Estimate for comparison and sizing
- Recommend a Program TR frequency
- Flexible enough to handle What-If Synthesis
- Defendable / Tangible process
- Inexpensive Solution

| Originating Technical Requirements | Design Dependent Requirements | Define Technology Curves (Hardware & So | Define Technology Refresh Plan Mapping | Define CERs for Technology Refresh NRE C | Output Report Comparative Analysis Gene | Web Deployable via Windchill, MS Sharep | IETM Tech Documentation Level | Demo of the Integrated Suite | Support Cost CERs (Training, etc.) | COTS Cost Assessment Tools (Price, SEER | Sum of Coverage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4. Recognize Technology Insertion | | 10 | 10 | 10 | | | | | | | 30 |
| 6. What-if Scenario Capabilities | | | 3 | 3 | 6 | | | 3 | | 6 | 21 |
| 7. Distributed Processing/Geographic Distance | | | | | | 10 | | | | | 10 |
| 8. Software Development Content | | 3 | | | | | 3 | | 6 | | 12 |
| 9. Sample Application of Tools | | | | | | 3 | | 10 | | 6 | 19 |
| 10. Prototype of Process and Tools Experience | | | | | | 3 | | 10 | | 6 | 19 |
| 11. Tool Responsiveness | | | | | | 6 | | 6 | | | 12 |
| 12. Models for Costing | | | | 6 | 6 | | 6 | | 10 | 10 | 38 |
| 13. Required Expertise for Operation | | | 6 | | 6 | 3 | | 3 | | | 18 |
| SUM of Applicability (0 - 10 Scale) | | 13 | 19 | 19 | 18 | 25 | 9 | 32 | 16 | 28 | |

10 = Strongly Linked Design Dependency
6 = Medium Linked Design Dependency
3 = Low Linked Design Dependency

# Marketplace



***What is the marketplace for the research? Which LM program could use it?***

- ***TACTrac (a product now owned by i2, previously owned by TACTECH). Part level (capacitor, transistors, etc.) obsolescence database, with extensive industry probing and data gathering. Very expensive product (about $20,000 plus annual fees for weekly updates). It rates a product on a scale of 1(new) to 5(obsolete). Provides warnings of impending obsolescence.***
- ***LCE (also owned by i2, their original product), also expensive, and uses the TACTrac model of data gathering and database management. Same idea, get data from industry, compile and sell.***
- ***MOCA (University of Maryland, CALCE organization) is a research-level C++ programmed Graduate project. It takes output from a TACTrac or LCE and uses it to predict a program Tech Refresh point. It uses production schedules and part tracking. Still too low a level for consideration. No cost data (no sales yet).***

# R2T2 Approach



- ***R2T2 performance is based on:***
  - *Engineering data and technology assessment inputs*
  - *Develops a program-level synchronous TR frequency*
  - *Optimizes the recommended TR frequency based on life cycle cost*
  - *Develops a TR Plan for each refresh point, identifying necessary changes by part number.*
  - *Develops a Life Cycle Plan for each system serial number*
  - *Allows for What-if Analysis to compare baseline options quickly*
  - *Provides a quick/coarse Reliability Assessment for comparisons*
  - *Develops a coarse Cost Estimate (can use Price or ICE as desired)*
  - *Integrated, Web-deployed, uses databases (no shadowing)*
  - *Clean, open architecture implementation maximizing flexibility*

# R2T2 Optimization Strategy

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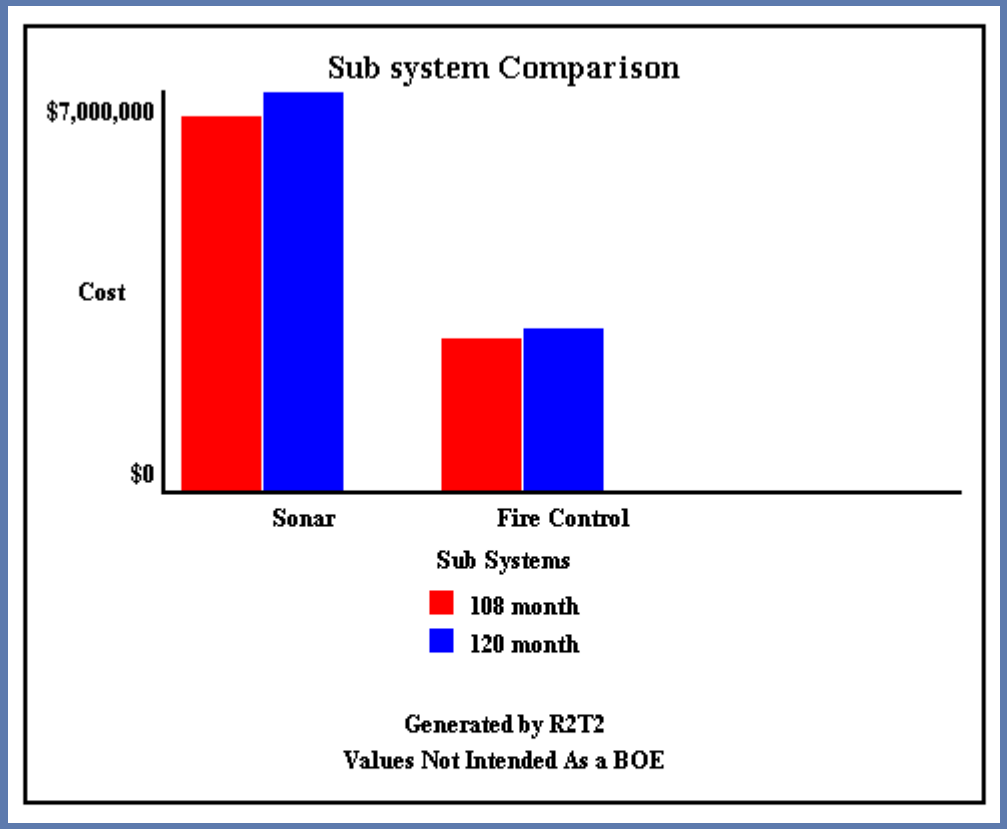
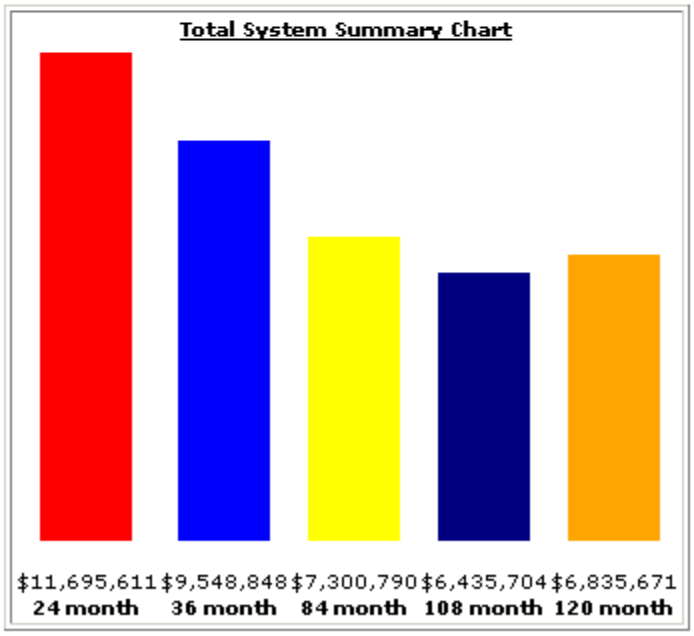
- Easy Side by Side Comparison of Strategies
- Increased, Customizable Graphing Capabilities




| Strategy | System Total |
|---|---|
| 24 Month | $11,695,611 |
| 36 Month | $9,548,848 |
| 84 Month | $7,300,790 |
| 108 Month | $6,435,704 |
| 120 Month | $6,835,671 |

Show Values on chart ☑

Display



# R2T2 Tech Refresh Screens

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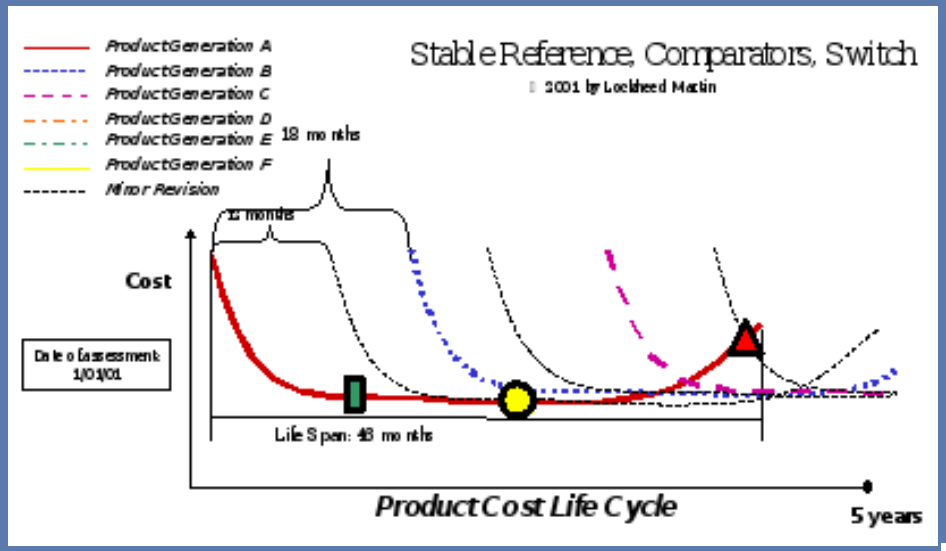
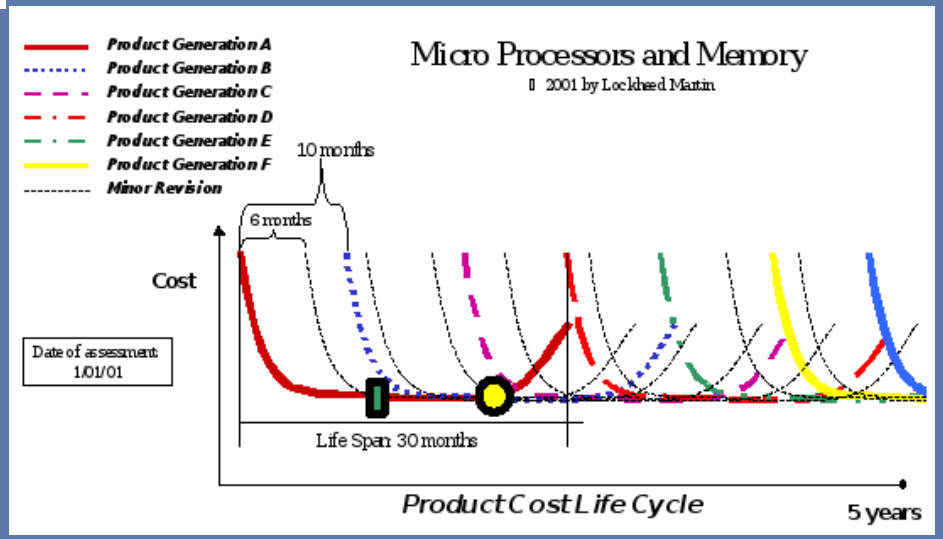



These charts represent some of the technology groupings for the VME System.




The charts plot the maturity of the system components and the projected cost associated with a given functionality.

# R2T2 System Capacity Metrics

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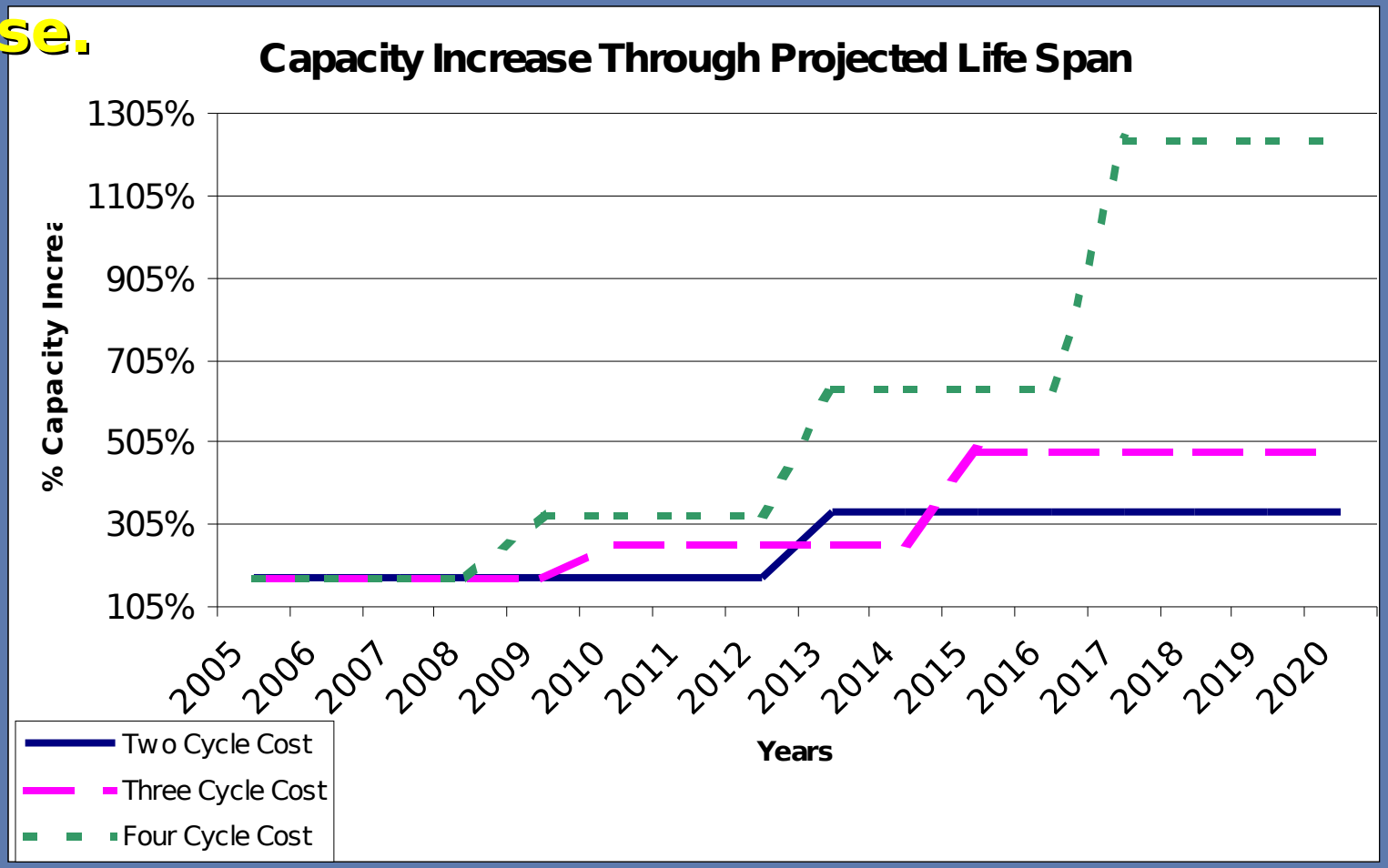
**By utilizing an optimized Technology Refreshment Strategy, this example system will very conservatively be able to realize a 1305% capacity increase.**



# R2T2 Example Analysis

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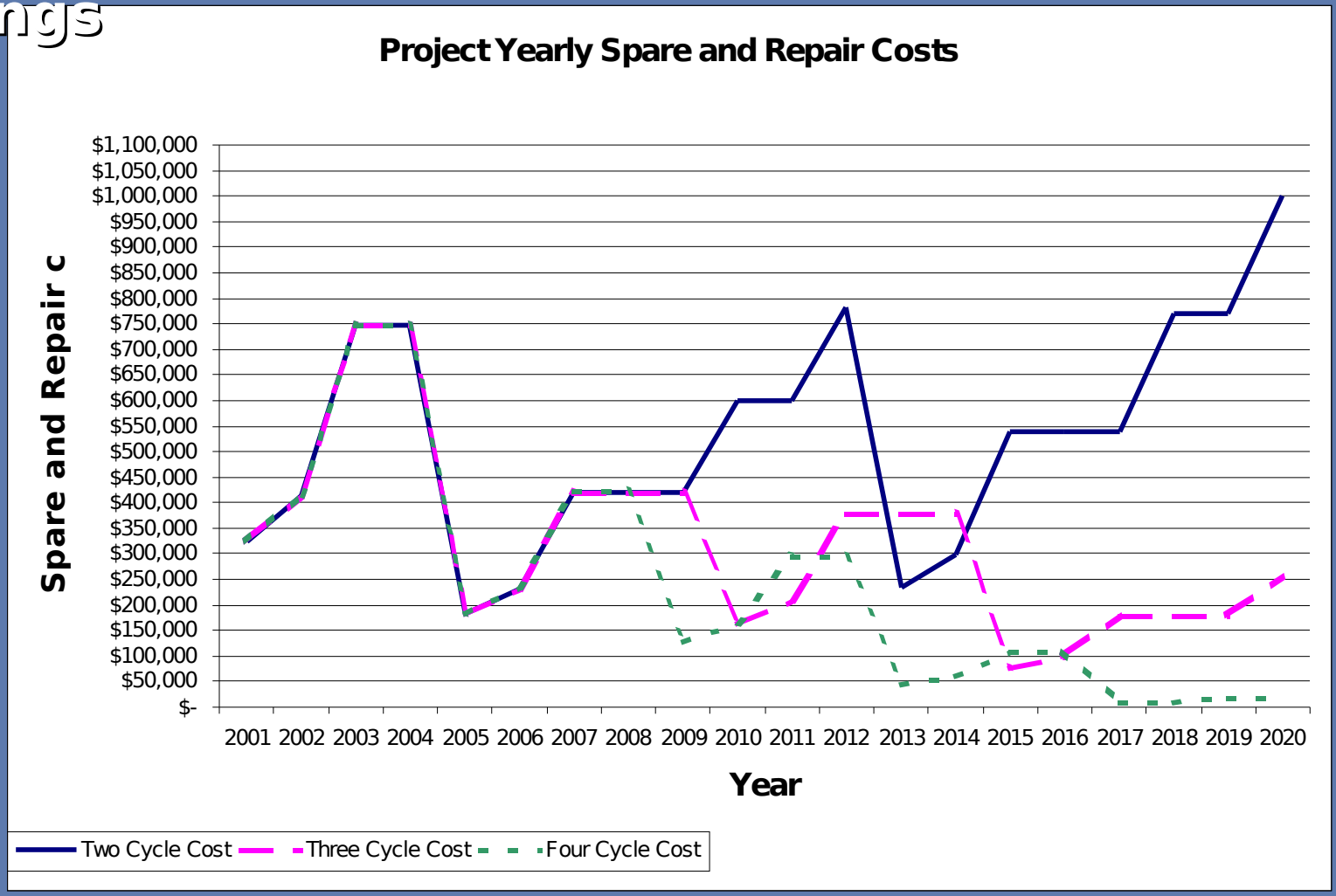
## In addition to the capacity increase, the optimal refresh strategy also represents a tremendous cost savings

- The cost savings in the last year alone make up ALL the additional costs for NRE



# R2T2 Example Analysis

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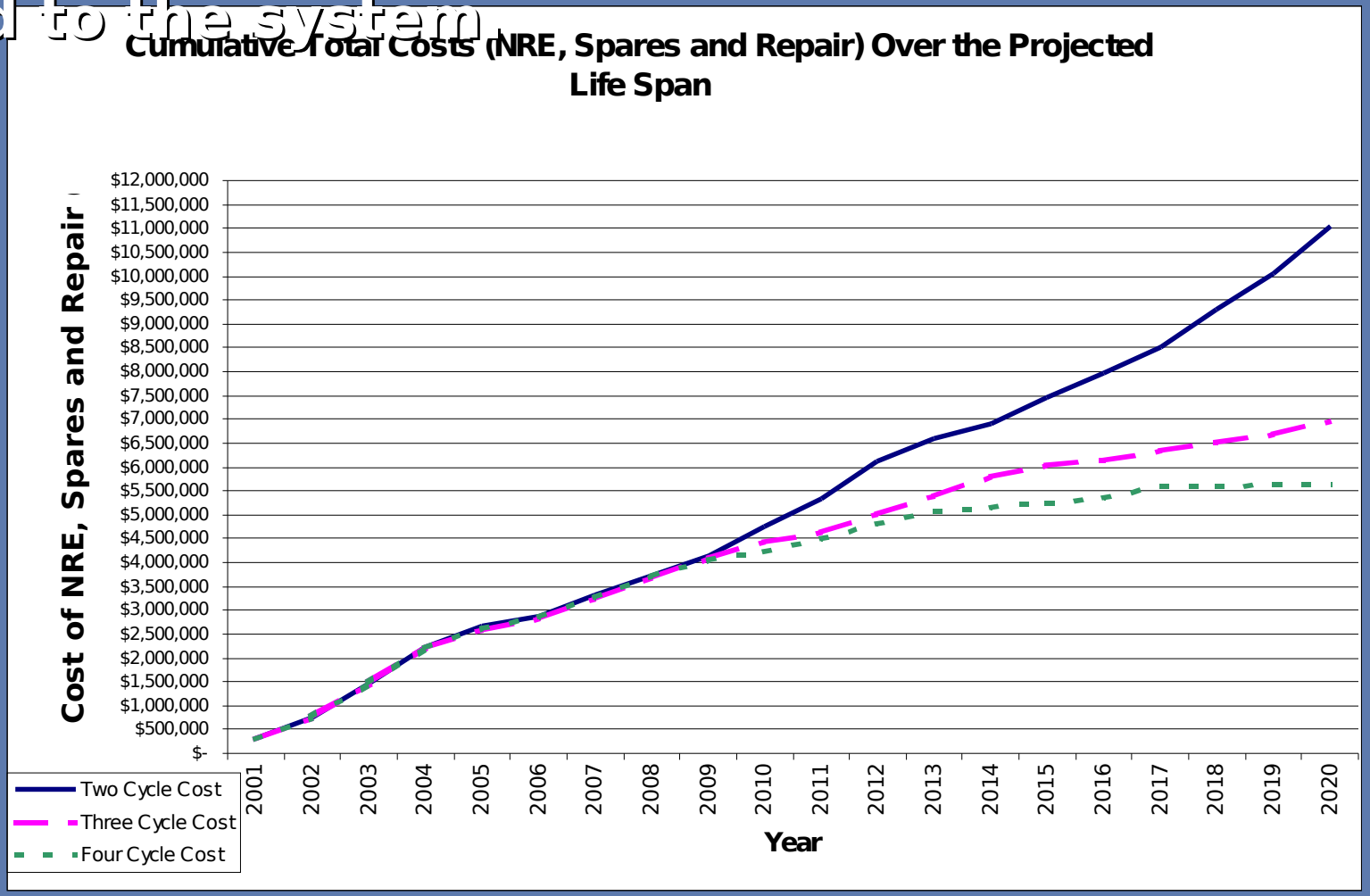
**The cost savings of the optimized system become even more substantial when acquisition costs are added to the system.**



# R2T2 Summary



- *Thin Client Web-based Application*
- *Requiring minimal user inputs*
- *Providing comparative costs for trade analysis*
- *Provides Technology Refreshment Strategy*
- *Provides a line-item analysis of Technology Refresh Planning (Changes in time and magnitude)*
- *Capacity assessment performed over life cycle*